(12) UK Patent Application (19) GB (11) 2 036 202 A

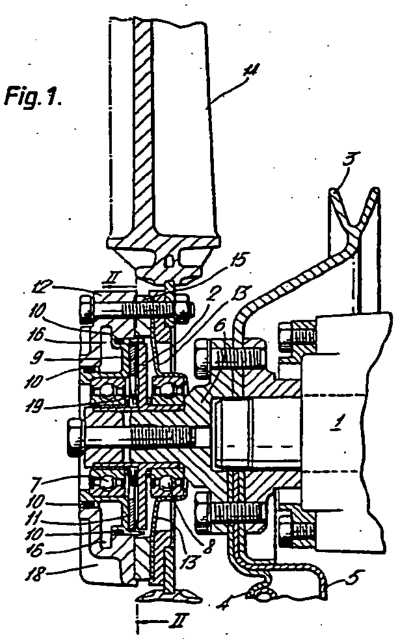
(21) Application No 7936084
(22) Date of filing 17 Oct 1979
(30) Priority data
(31) 78/41351
(32) 20 Oct 1978
(33) United Kingdom (GB)
(43) Application published 25 Jun 1980
(51) INT CL³ F16D 43/28
(52) Domestic classification F2C 1C12A 1C2A1 1C4B2 1C4E 1C7 1C9B1
(56) Documents cited GB 958138
(58) Field of search F2C

(71) Applicant
Task Power and Control Limited
Sustanum works
Titchfield
Fareham
Hampshire
(72) Inventor
Kenneth Gordon Wallace
(74) Agents
Alan Tromans & Co

(54) Fan drive

(57) A clutch device for engaging and disengaging a cooling fan 14 for an engine 1 comprises an inner part 6 adapted to be driven by the engine and bearing a radially-outwardly directed flange 2, an outer part, an annular piston member 9 axially slidable with the outer part, the outer part and the piston being formed to define therebetween an annular space 16 disposed externally around the inner part and filled with wax which when melted expands to drive the piston member 9 in the direction of the flange 2, and an annular friction element 11 positioned to promote a driving engagement between the piston member 9 and the flange 2 on the melting of the wax. The arrangement is such that slipping between the piston member and the flange as the driving engagement is being established, generates heat which is transferred to the wax and thereby reduces the slipping. The outer part is provided with fins 18 and with radial passages for cooling purposes.

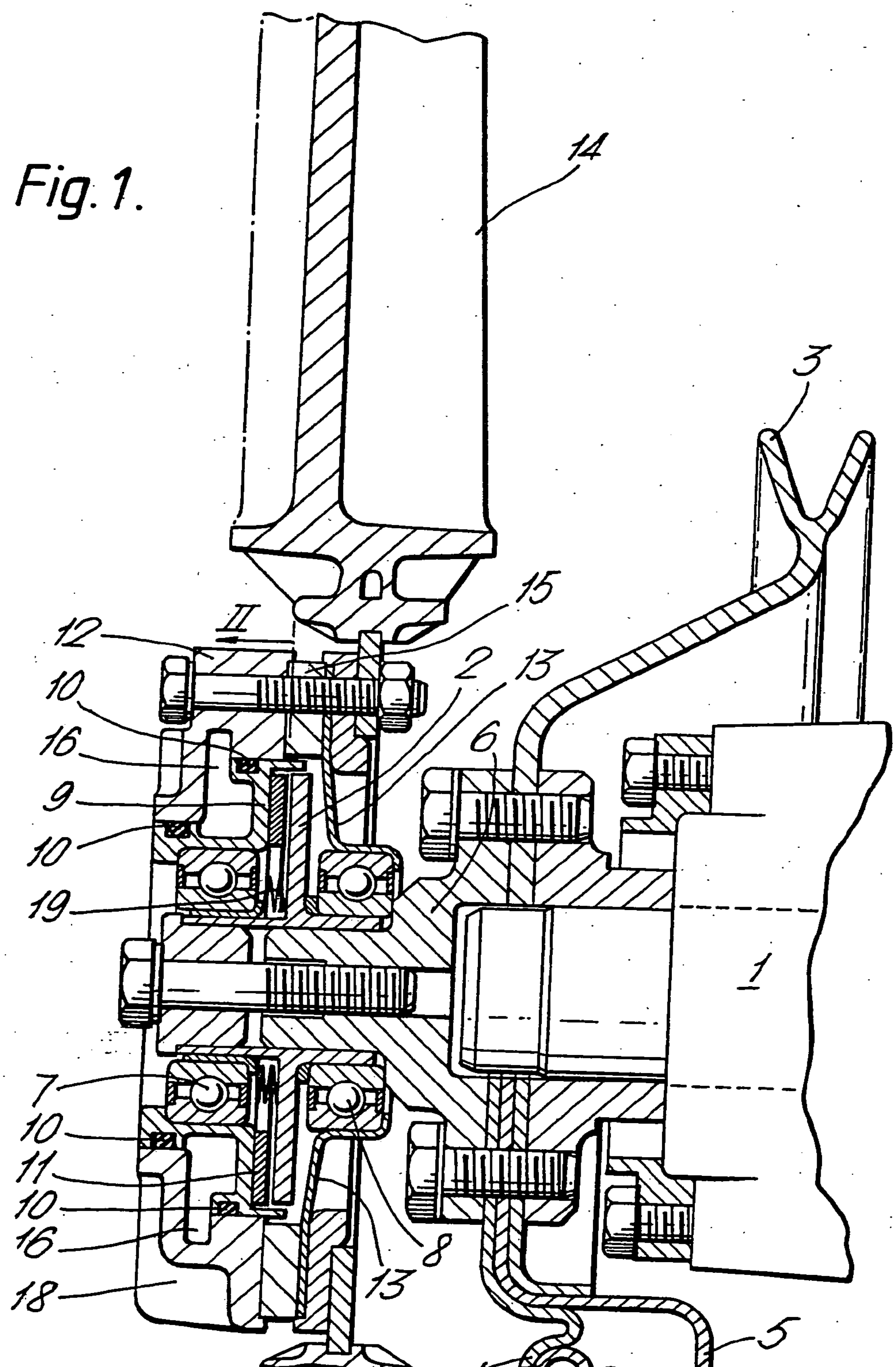
Fig. 1.



The drawings originally filed were informal and the print here reproduced is taken from a later filed formal copy.

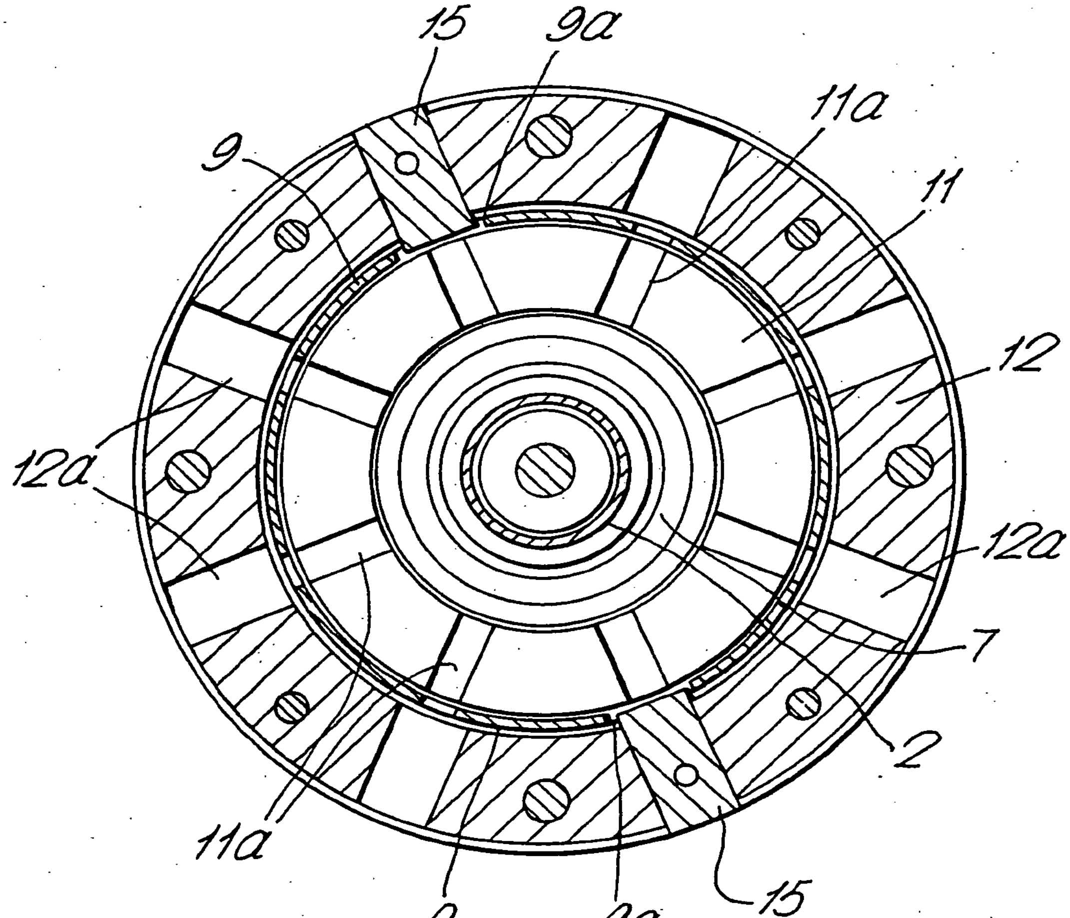
GB 2 036 202 A

Fig. 1.



2036202

Fig. 2.



SPECIFICATION

Fan drive

The present invention relates to fan drives.

In our Specification No. 1,455,189 we have described a clutch device for operating the cooling fan of an engine. This device has a wax-filled member, the expansion and contraction of which as the wax melts or solidifies engages and disengages a cooling fan. We have shown in that Specification the importance of arranging the rate of transfer of heat to and from the wax to ensure satisfactory and reliable operation. An object of the present invention is to provide a form of clutch device having improved heat-transfer arrangements.

By the present invention, there is provided a clutch device for engaging and disengaging a cooling fan for an engine which comprises an inner part adapted to be driven by the engine and bearing a radially-outwardly directed flange, an outer part, an annular piston member axially slidable with the outer part, the outer part and the piston being formed to define therebetween an annular space disposed externally around the inner part and filled with wax which when melted expands to drive the piston member in the direction of the flange, and an annular friction element positioned to promote a driving engagement between the piston and the flange on the melting of the wax, the arrangement being such that slipping between the piston member and/or the flange as the driving engagement is being established, generates heat which is transferred to the wax and thereby reduces the slipping as the engagement is being established.

It is found in practice that although the heat generated substantially increases the speed at which the driving engagement is established, the disengagement on solidification of the wax can be made to occur without substantial slowing by heat generated during the disengagement by arranging, as is preferred, that the outer part has an adequate thermal capacity. The thermal capacity required of the outer part depends upon the intended application of the device. For most purposes, using aluminium as the material of the casing and a wax which undergoes a complete change of state over a range of less than 10°C, the mass of the outer part should be from 10 to 20 times that of the wax. Aluminium is preferred as the material of the outer part because of its thermal conductivity and favourable cost. Less conductive materials require to be provided in greater mass. Providing fins upon the outer part assists the dissipation of heat and thereby improves the speed of disengagement.

The piston is preferably backed by a spring loading. Such loading is conveniently provided in the form of a diaphragm which, for optimum results is adjustable. e.g. by means of one or more screws.

Improved rapidity of disengagement may be obtained by promoting the passage of air in contact with the outer part. This may be achieved by forming the outer part, or an attachment in thermal communication therewith, with radial slots which serve to produce a flow of air by centrifugal action. Such slots may be formed in the friction element itself if desired.

In a preferred arrangement involving radial slots as aforesaid, the supply of air to the slots is promoted by providing axially extending grooves in the inner face of the annular piston.

The following description in which reference is made to the accompanying drawings is given in order to illustrate the invention. In the drawings:

Figure 1 shows a preferred embodiment of the clutch in axial cross section, and

Figure 2 is a cross section taken along II–II of Fig. 1.

The drawings show a general arrangement of the assembly mounted on the fornt of an engine 1 and immediately to the rear of the engine coolant radiator (not shown). A rotor 2 is continuously driven by the engine via the belt pulley 3 and connecting parts 6. Belt pulleys 4 and 5 are alternatives to 3. Two ballraces 7 and 8, preferably of the sealed type to retain lubricant, are mounted on the rotor 2 on either side of the central flange. Ballrace 7 carries a piston 9 which is free to move axially. A heat insulating sleeve may be interposed between bearing 7 and piston 9 if desired to reduce stray heat from the bearing reaching the operating material 16.

The piston 9 carries a friction disc 11 which may be engaged with the central flange of the rotor 2. A spring 19 normally holds the friction disc away from the rotor 2.

An outer casing 12 is supported by the piston 9 and also by a diaphragm 13, which is carried by bearing 8. Casing 12 carries the fan blades 14. Two driving pegs 15 engage with two of a set of slots $9a$ in the piston 9 to ensure that the casing 12 rotates at all times with piston 9.

The operating material 16 is contained in a space between the outer casing 12 and piston 9. Seals 10 are provided to retain the operating material 16 and arrangements are also made for replenishment thereof through a feed hole.

Air passing through the coolant radiator flows next over the outer casing 12 which is thereby kept at the same temperature as the air. This action is assisted by fins 18 on the casing 12 which either take in heat from the air flow to raise the temperature of the casing 12 if the air is at a higher temperature than the casing or vice versa. The temperature of the operating material 16 contained within the casing 12 rises or falls to follow the tempera-

ture changes of the casing 12.

The slots 9*a* in the piston 9, slots 11*a* in the friction disc 11 and slots 12*a* in the casing 12 enable air to flow over the bearing 7, then between the friction disc 11 and the rotor 2 and finally out through radial slots between the casing 12 and diaphragm 13. This air flow is promoted and maintained by slots 12*a* in the casing 12 acting as a centrifugal fan. The purpose of this air flow is to improve further the transfer of heat from the radiator air to the operating material 16 or vice versa.

The action of the device is as follows:–

When the engine is first started the coolant is at ambient temperature and so too is the operating material 16. The friction disc 11 is held away from the rotating rotor by the spring 19. The outer casing 12 rotates slowly because of friction in bearings 7 and 8 and this movement is sufficient to draw air from the coolant radiator over the casing 12 if the vehicle is stationary. When the air from the coolant radiator reaches a pre-selected temperature, the operating material 16 has increased in volume sufficiently to move the piston 9 axially against the spring 19 to bring the friction disc 11 into contact with the rotor 2. The engagement is gradual so that the angular acceleration of the fan is well within the tolerable limits of shear stress in the fan blades. Because of their close proximity, heat generated by slipping during clutch engagement is passed quickly into the operating material 16 and this shortens the period during which slipping is taking place and reduces wear on the friction disc. The fan now runs at a higher speed than before the clutch was engaged and so draws extra air through the coolant radiator. This tends to reduce the temperature of the coolant.

Damage due to overtravel of the piston 9 on further increases in temperature (particularly when the friction disc 11 is new and unworn) is prevented by flexing of the diaphragm 13 which allows the casing 12 to move away from the engine during any further expansion of the operating material 16. This feature also provides compensation for wear of the friction disc 11 and ensures satisfactory engagement of the clutch even when some wear has taken place.

Should the temperature of the air from the coolant radiator fall below the pre-selected value, the operating material 16 decreases in volume and allows the spring 19 to move the piston 9 so as to disengage the friction disc 11 from the continuously rotating rotor 2. Any heat generated by friction due to slipping of the clutch during disengagement is dispersed rapidly by the air flow through the radial slots described earlier. The fins 18 are particularly useful during clutch disengagement because the fan is then rotating rapidly and so heat is dissipated quickly through the fins thereby promoting rapid disengagement with a minimum of slipping. With the clutch disengaged the fan slows down and reduces the volume of air passing through the coolant radiator. This tends to increase the temperature of the coolant.

The system therefore tends to vary the volume of cooling air drawn through the coolant radiator in the manner required to maintain a reasonably constant temperature.

CLAIMS

1. A clutch device for engaging and disengaging a cooling fan for an engine which comprises an inner part adapted to be driven by the engine and bearing a radially-outwardly directed flange, an outer part, an annular piston member axially slidable with the outer part, the outer part and the piston being formed to define therebetween an annular space disposed externally around the inner part and filled with wax which when melted expands to drive the piston member in the direction of the flange, and an annular friction element positioned to promote a driving engagement between the piston and the flange on the melting of the wax, the arrangement being such that slipping between the piston member and/or the flange as the driving engagement is being established, generates heat which is transferred to the wax and thereby reduces the slipping as the engagement is being established.

2. A device according to Claim 1 in which the outer part is formed of aluminium.

3. A device according to either of Claims 1 or 2 in which the mass of the outer part is from 10 to 20 times that of the wax.

4. A device according to any one of Claims 1 to 3 in which the outer part is formed with fins for assisting the dissipation of heat.

5. A device according to any one of Claims 1 to 4 in which the piston is backed by a spring loading.

6. A device according to Claim 5 in which the spring loading is provided in the form of a diaphragm.

7. A device according to Claim 6 in which the diaphragm is adjustable.

8. A device according to any one of Claims 1 to 7 in which the outer part, or an attachment in thermal communication therewith, is formed with radial slots which serve to produce a flow of air by centrifugal action.

9. A device according to Claim 8 in which the inner face of the annular piston is provided with axially extending grooves for promoting the supply of air to the radial slots.

10. A clutch device, substantially as hereinbefore described and illustrated by reference to the accompanying drawing.

11. An engine provided with a clutch device according to any one of Claims 1 to 10,

said clutch device operating substantially as hereinbefore described.

Printed for Her Majesty's Stationery Office
by Burgess & Son (Abingdon) Ltd.—1980.
Published at The Patent Office, 25 Southampton Buildings,
London, WC2A 1AY, from which copies may be obtained.